DOCUMENT RESUME

ED 078 774 HE 004 370

AUTHOR	Solomon, L. C.
TITLE	Schooling and Subsequent Success: Influence of Ability, Background, and Formal Education.
INSTITUTION	American Coll. Testing Program, Iowa City, Iowa. Research and Development Div.
PUB DATE	Apr 73
NOTE	37p.
AVAILABLE FROM	Publication and Information Services Division, The American College Testing Program, P.O. Box 168, Iowa City, Iowa 52240 ($1.00)
EDRS PRICE	MF-$0.65 HC-$3.29
DESCRIPTORS	Aspiration; Career Opportunities; Costs; Economic Status; Educational Background; *Educational Benefits; Educational Finance; Educational Quality; Failure Factors; *Higher Education; Income; Rewards; *Social Mobility; Social Opportunities; *Socioeconomic Status; *Success Factors

ABSTRACT

The first section of this paper serves to define the various types of costs and benefits of higher education. It differentiates between private and social costs and benefits, as well as between monetary and nonmonetary costs and benefits. It is further argued that we must look at costs and benefits that arise not only during or immediately after the schooling experience but also at those that arise later. The work on the impact of higher education to date is reviewed. An attempt is made to relate the results from a few studies of lower levels of education to those dealing with college. The next section focuses on recent work of the author, in which he attempts to define measures of college quality and introduce them into an earning function. It appears that both quantity and quality of schooling are important factors to explain lifetime income patterns of individuals, even after controlling for the individual's innate ability. The two most significant measures of quality in a statistical sense are average SAT scores of entering freshmen and average faculty salary. It appears that these two factors have independent influences on lifetime earnings. A 43-item bibliography is included. (Author/MJM)

ED 078774

ACT RESEARCH REPORT

No. 57

57

April 1973

SCHCOLING AND SUBSEQUENT SUCCESS: INFLUENCE OF ABILITY, BACKGROUND, AND FORMAL EDUCATION

L. C. Solmon

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PUBLISHED BY THE RESEARCH AND DEVELOPMENT DIVISION

THE AMERICAN COLLEGE TESTING PROGRAM

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ABSTRACT

The first section of this paper serves to define the various types of costs and benefits of higher education. It differentiates between private and social costs and benefits, as well as between monetary and nonmonetary costs and benefits. It is further argued that we must look at costs and benefits that arise not only during or immediately after the schooling experience but also those that arise later on.

The work on the impacts of higher education to date—primarily that of economists and sociologists—is reviewed. An attempt is made to relate the results from a few studies of lower levels of education to those dealing with college. Brief mention is also made of some studies that look at changes in cognitive and affective aptitudes between the time an individual enters college and the time he leaves. It is pointed out that economists originally focused on the relationship between years of schooling and subsequent income, but have more recently focused on the effects on the income-schooling relationship of innate ability and family background. Studies with varying conclusions regarding the interaction between these variables in the earnings function are reconciled as much as possible. It is argued that future work will have to adjust schooling attainment by a factor to take account of differing qualities of institutions attended.

The work of a number of sociologists is then surveyed, with the observation that the general concepts studied do not differ much from those of the economists. Note is made of the use of linear causal models (path analysis) by sociologists. The dependent variable studied by most sociologists has been occupational status attained by those attending college. Some of the studies follow changes in occupational status over time; some attempt to differentiate the impacts of certain variables, depending upon the races of the individuals studied. As economists focus more on the effect of socioeconomic status and the sociologists begin to look at the impacts of schooling on income rather than on occupational status, the interrelationship of the two disciplines' work becomes apparent.

The next section focuses on recent work of the author, in which he attempts to define measures of college quality and introduce them into an earnings function. It appears that both quantity and quality of schooling are important factors to explain lifetime income patterns of individuals, even after controlling for the individual's innate ability. The two most significant measures of quality in a statistical sense are average SAT scores of entering freshmen (a peer group effect) and average faculty salary. It appears that these two factors have independent influences on lifetime earnings. College quality has an increasing impact on earnings over the lifetime; that is, quality has a larger and more significant coefficient when explaining income 20 years after graduation, compared to its impact in explaining income after only 8 years. College quality does not have a significant influence upon income in the initial year of earnings, although there is some question about the efficacy of the first year's earnings data. It also appears that college quality is more important for high-ability students than for low-ability students and that college quality has greater impact the more years one attended.

Prepared by the Research and Development Division
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SCHOOLING AND SUBSEQUENT SUCCESS: INFLUENCE OF ABILITY, BACKGROUND, AND FORMAL EDUCATION

A Review of the Literature and Extensions

Lewis C. Solmon[1]

The Costs and Benefits of Higher Education

Obtaining higher education imposes costs and yields benefits. To the individual obtaining the education or to his family, the costs may be direct or indirect. The first direct type of costs is monies laid out for tuition, books, transportation to and from school, etc. One type of indirect cost is increased taxes which support institutions of higher education. The largest cost of schooling to the individual is generally considered to be the opportunity cost or earnings foregone by the student when staying in school rather than taking a job.

Of course, individuals seek schooling because of the benefits they receive from attendance. These benefits can be monetary, i.e., increased income due to the educational experience, or nonpecuniary. There is now a literature developing on what aspects of the educational experience serve to enable those being educated to subsequently earn higher incomes. Certainly, increases in knowledge gained in school are productive. However, increased socialization, willingness to take risk, and willingness to innovate are other income-incrementing characteristics which might be obtained from the educational experience. Besides increases in income, nonpecuniary returns from extra schooling are also being recognized more and more. It has been argued that those with more education are more efficient consumers, i.e., the more educated use their time more efficiently. Some people argue that the enjoyment obtained from reading a good novel is higher for those with more education compared with those with less.

Two caveats must be inserted at this point. In regard to private pecuniary returns, it has been alleged that incomes are larger for those with more education not because of increased skills and productivity obtained in school but merely because educational attainment serves as a credential for which employers are willing to pay more, despite the fact that there is no real difference in an educated and a less-educated man. Lack of education may be a barrier to entry into high-paying occupations. On the nonpecuniary side, when one observes people with more education exhibiting characteristics different from those with less education, one has to ask whether these more-educated people would have exhibited the same characteristics even if they had not been educated; i.e., if one observes different attributes of people categorized by their educational attainment, would the same differences have been apparent when comparing the two groups even if they had ended up with the same amount of education?

Besides the costs and benefits accruing to the particular people being educated, there are costs and benefits of education which accrue to society as a whole. In other words, when an individual obtains schooling, the rest of society might reap some benefits and might incur some costs as well. Some of these benefits are shared, i.e., they accrue both to the person being educated and to others in society. Others accrue more to society and less directly to

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the individual. It is traditionally alleged that the more-educated society is a better functioning democracy. This allegation might provide only slight concrete benefit to one individual who has been educated. On the other hand, it has been argued that education, particularly of females who later become mothers, provides benefits to subsequent generations of children. There is evidence that children of more-educated mothers become ultimately more successful than children of less-educated mothers, controlling for a large number of other factors. In a sense, this is a social return because the benefit is accruing to one other than the person being educated. Furthermore, the mother certainly gets some benefit out of both training the child and observing later success.

On the cost side, it may be argued that a more-educated society is a more-alienated society. Some have even gone so far as to say that rather than a more-educated society being a more homogeneous and cooperative society, more-educated people are better able to recognize differences among individuals and tend ultimately to become less tolerant. Moreover, in a society where some individuals are educated more and some less, one might observe a widely dispersed distribution of income. In other words, those being educated end up high on the income and occupational prestige ladder, whereas the less educated end up on the lower rungs. This might result in social discontent, as has been observed in this country in recent years.

It is quite apparent that different attitudes and policies toward higher education will yield widely different problems and consequences. For example, in a society where higher education is considered a right for all of its youth, i.e., higher education for the masses, the problems will be much different than in a society where higher education is considered only for the elite. Of course, the direction of these differences is not clear. One might intuitively expect that in a society with mass higher education, there would be less divergence of income and less social discontent. However, unfulfilled expectations from higher education, when minorities are led to believe that higher education is the panacea for all ills and then find that this panacea was merely a placebo, might yield great discontent. An elitist higher education might serve to dampen the expectations of the masses, and hence, have less discontent from unrealized expectations. Of course, entirely different institutional structures will be needed in order to operate an elitist system of higher education rather than a system for providing higher education for the masses.

The private and social costs and benefits of higher education will very clearly be a function of both the quantity and the quality of schooling provided in a society. In order to clearly understand the implications of costs and benefits of higher education, one has to study private versus public school systems separately, including private and public institutions of higher education; the effects of different types of colleges; and, indeed, the effects of different types of post-high school experience (whether that be adult education, on-the-job training, vocational training, apprenticeship programs, etc.). For example, one really does not know whether any of the benefits from higher education are due to faculty quality and whether faculty quality is best measured by teaching capabilities, attitudes, training, or research activities of the faculty members.

So far the concept of time has not entered into the discussion of costs and benefits of education. It is apparent that most of the private costs—those incurred by the individual being educated or by his family—are incurred at the time of education (although incomes of graduates might be lower than those of less-educated peers of the same age during the former's first few years in the work force due to the lower amount of on-the-job experience of those who had attended school). However, social costs from education might linger over a longer period of time, such as social discontent which rages for many years after attempts are made to upgrade the education of poor minorities.

The payoff to education, whether to individuals or to society, can appear during the schooling experience, immediately thereafter, or over a period of years after the individual leaves school. Chopin might be better appreciated after a freshman music course. An individual with a college degree might step into a higher status job immediately after graduation than could a peer with equal ability and motivation but without the college degree. However, the quantity and the quality of education explain differences in incomes among individuals after 20 years in the labor force much more than they explain differences in incomes of individuals immediately upon leaving school. One reason for this increased explanatory power of education over time is that those with more in-school education tend to spend more time in acquiring on-the-job training upon the completion of their formal education.

The time of accrual of benefits from higher education is a particularly important issue when attempting to evaluate the effectiveness of educational inputs. Ideally, one would want to look

at the change in attributes of the student between the time he or she entered college and the time he or she left in order to evaluate the effectiveness of the institution. The effects of schooling are not all immediately realized when the diploma is received. For example, as mentioned in the case of incomes, it appears that full value from education accrues over the whole post-school earnings period. The problem with the earnings measure, of course, is that many other events impinge upon the earnings potential of an individual between the time of graduation and the time of, say, peak earnings 20 or 30 years later. In order to net out the effects of education on income 20 years later, one would have to control for those factors or events occurring between the time the individual leaves school and the time he or she receives the income with which we are concerned. To summarize, the advantage of looking at the effectiveness of educational institutions by studying changes in the individual between the time he or she enters college and the time he or she leaves is that no post-school events cloud the effects of schooling. On the other hand, many effects of schooling are not realized until many years later. The disadvantage of studying schools' effectiveness 20 years later is the fact that events subsequent to schooling also come into play.

Although some of the immediately obtainable benefits from higher education such as personality changes, increases in knowledge, etc., might be deemed beneficial directly, several additional questions must be asked. First, to what extent do the trait changes effected by the college experience persist? If one observes energetic entering freshmen becoming lethargic graduating seniors, can one predict that this lethargy will continue throughout the life, or will it change into even greater enthusiasm once the graduates have rested from their senior final exams? Secondly, to what extent are the character changes or other changes obtained during the educational experience of value to the individual (and to society)? It might indeed be that increased socialization is good, since the socialized individual is a more cooperative and productive member of society; or it may be bad, since the more socialized graduate is less free-thinking and less innovative.

Must one stop here and leave it up to the reader to evaluate whether certain traits acquired should be put on the plus or on the minus side? If one could define some "good," such as income or occupational status, which is generally, but perhaps not universally, agreed upon, then one might argue that those characteristics acquired in school which are associated with higher quantities of this "good" yield private or social benefits. However, once these goods are identified, then why not relate education and educational inputs to the acquisition of these inputs (such as income) directly rather than looking at educational outputs acquired immediately upon graduation, but whose worth depends upon how well they are converted into the "goods" over the rest of the former students' lives?

In order to get a proper measure of the relationship between education and these goods which might be acquired as a result of characteristics obtained while in school, one must control for those factors prior and subsequent to schooling which impinge upon the education-income (or job status) relationship. This is the approach to the study of private benefits of schooling taken by most economists, the author included, and also by many sociologists. The general problem is to explain income or occupational status over the post-school earning life by quantity and quality of education, other factors acquired before the education, such as ability, and factors acquired subsequent to schooling, such as on-the-job training or wealth of wife's father.

The purpose here is to review some of the important studies which look at the relationship between education and two specific benefits to the recipient of it—income and occupational status. A few studies using measures of output upon completion of schooling will also be considered. Then the author's own work on the definition and impact of quality of institutions of higher education will be discussed. In his work, the author attempts to explain individual income differences at several points in the life cycle by differences in personal characteristics and by characteristics of the educational institutions which were attended.

Review of the Work to Date

A number of the studies which relate educational inputs to outputs observable immediately upon completion of schooling deal with levels of education below the college level. Although these are not directly relevant to the problem at hand, they are important enough to note briefly as a beginning.

Eric Hanushek (1972) has studied two data sets: (a) a single California school system and (b) a sample of urban schools in the Northeast and Great Lakes regions. Both analyses concentrate upon elementary education and, in particular, upon the production of achievement levels or cognitive ability. Hanushek summarizes his findings as follows:

> There is no doubt that family background has a pervasive and powerful impact on student achievement; higher socioeconomic status is systematically related to higher achievement.... The importance of the quantity and quality of school inputs is more interesting than the importance of family backgrounds. The analyses indicate that differences among teachers have a significant impact upon the achievement of students.... [However] factors which are purchased by the school system are not for the most part the characteristics of schools and teachers which are important in determining achievement levels. The bulk of instructional expenditures go toward the purchase of three classes of inputs: class size, teacher experience, and teacher graduate education.... The characteristics of teachers which appear important in the estimated models include teacher verbal ability..., recentness of teacher educational experiences and proportion of nonwhite teachers (which may be interpreted as a measure of the quality of educational experiences of nonwhite teachers) [pp. 108-110].

Hanushek pointed out that these findings implicitly indicate that differences in per-pupil expenditures will not be systematically related to differences in student achievement. The reason for this is that school funds are not spent to purchase those inputs which have the important effects on student achievement. The lesson one can learn from Hanushek's study is that to measure quality of institutions of higher education merely by expenditures per student misses the point. One must know where these expenditures are made, whether it is to acquire the "proper attributes" of faculty or on other aspects of the college environment which are productive. Obviously, the school with the large expenditure per student, if it is used to finance a football program, is not going to be the quality institution we are trying to find.

A paper by Finis Welch (1972) attempted to explain black-white differences in returns to schooling. He now feels there were errors in his earlier work, which said that to a southern, rural black schooling was a poor investment. The reason was the quality of schooling was not considered.

> The majority of the black, adult population in 1959 had last attended school in the decades of the 20's and 30's. During those periods Negroes attended school only about two-thirds as many days as whites.... Also, southern schools spent a little more than three times as much on white as on black pupils. In this context, it should not be surprising that schooling contributed much less to black income than to white.... Through time, the relative quality of black schooling has risen rapidly. This has been one of the major reasons for recent gains in relative black incomes [pp. 2, 3, 26].

Although Hanushek accounted for the initial ability of individual students and hence measured output as the *net* change in aptitude scores effected by the schools themselves, Welch was not able to introduce ability into his discussion. In explaining black-white income differences, there were no measures of aggregate differences in initial ability of the two groups. However, one can conclude from these very different studies that school inputs do have an effect on output of the school system, whether output is measured in terms of changes in achievement scores or ultimately in income differentials. Related studies which deal with higher education are discussed next.

Alexander Astin (1968) tried to determine the effects of certain traditional indices of institutional excellence on the intellectual achievement of the undergraduate student. Astin measured student output by scores on the area tests of the Graduate Record Examination. His sample dealt with students at colleges which required all seniors to take the area test; and, therefore, the student self-selection, which occurs in the Graduate Record Examination national program for graduate school selection, was not a factor. Astin controlled for initial ability of the students by using as an independent variable their scores on the National Merit Scholarship Qualifying Test (taken before entering college). A wide array of other student input control measures was also used.

Astin's analysis failed to confirm the hypothesis that the students' achievement in social sciences, humanities, or natural sciences is facilitated either by the intellectual level of his or her classmates or by the level of academic competitiveness or financial resources of his or her institution. Similarly, the evidence did not support the contention that the bright student benefits more than does the average student from exposure to these assumed indices of institutional "quality." He found that differences in student achievement during the senior year were much more highly dependent upon variations in student characteristics that existed before entrance into college than upon the characteristics of the undergraduate college attended.

A subsequent study by Centra and Rock (1971) investigated selected features of the college environment which were presumed to be related to students achieving significantly more or less than one would predict from their aptitude at entrance Contrary to the Astin study, their results did suggest

that college environmental features are related to student achievement. In particular, students appeared to learn more than might be expected if they felt that instructors were readily accessible, interested in teaching, and interested in students as individuals. Also related to the overachievement were college environments in which students perceive freedom in choosing courses and could try out a variety of courses before selecting a major. High scores on the cultural facilities factor of a university, which indicate excellent facilities in music and art, as well as what the students view as rich cultural programs, were related to overachievement in the humanities but underachievement in the natural sciences tests.

The Centra and Rock study used a sample of 27 colleges, generally small, liberal arts institutions, which they allege might be expected to emphasize educational output as measured by the GRE Area Tests. The students studied were those who, by their own choosing, took the Graduate Record Exams in their senior year. The implication here is that one is dealing with a rather select group who had at least some interest in doing post-college work.

A study by Paul Heist and associates (1961) concluded that the students of high ability attending highly productive institutions have a pattern of traits, values, and attitudes which is more closely related to serious intellectual pursuits than have students of high ability attending less productive institutions. This was in conjunction with a study in which productivity (quality) of colleges is measured by the number of a college's baccalaureates who go on to win PhD's. The high productivity of some schools is the outcome not only of quality of student inputs or the college itself but also a fortunate combination of faculty and student expectations, interests, and values.

Although the Astin work was differently enough conceived from the other two studies so that one need not spend a large amount of time reconciling the results, it appears that the outcomes were not inconsistent. The work by Taubman and Wales (in press) and the author's work reported upon below indicate that the effects of college quality are not linear; i.e., in general, high-ability students get more out of "good" schools than do students with less ability.

The Astin study looked at a rather general group of college students and found little impact of college quality on achievement. The Centra and Rock and the Heist studies looked at much more selective groups of students and found that attributes of the college mattered. In other words, if one combines the results, the implication is that if colleges matter, they matter to better students.

In a review article on the determinants of effectiveness in higher education, Robert Berls (1969) pointed out that tests of academic potential or cognitive achievement probably represent only a partial description of the likelihood of real-life accomplishment in those professions requiring above-average mental ability. He pointed out that the relationship between verbal intelligence and creativity is curvilinear, but at about 120 IQ the slope of the curve drops sharply so that the two variables, while still correlated, are less so than at lower points in the IQ range. One implication here is that changes in attitudes or aptitudes due to the school experience are of value only to the extent that subsequent success is altered by the changes in these characteristics. In other words, one wants ultimately to measure the success or contribution of the schooling experience by its contribution to the success in later life. The later-life success might be measured by income or by occupational status—others might argue that it should be measured by happiness.

Recent work by Ellis Page (1972) acknowledged these kinds of problems and relationships:

> Educational research and development have repeatedly run aground in the fog of undefined goals. Long range human goals, such as "happiness," "adjustment," or "equality" seem too remote from curriculum to be useful in educational planning. . . . Lack of an overall *effectiveness criterion*, therefore, makes it difficult to apply management science techniques in education [pp. 33-34].

Page proposed a method for reducing student profiles to single scores, in units known as the bentee. He hoped to obtain a reasonably strong consensus of what constitutes sound education for the graduating high school senior. One then would be able to relate inputs of colleges to output measured in bentee units. Although this unit of educational output might be more general than the measures of increments in ability, the same problem remains: What is the value of educational output measured upon completion of the educational experience in terms of subsequent success in life?

Although educators and psychologists have long been interested in immediate outputs of institutions of higher education, studies which look at the relationship between educational inputs and longer run outputs, such as income or occupational status, are not recent phenomena. As early as 1930, Donald Bridgman (1930) attempted to explain the success of American Telephone & Telegraph Company employees by their experiences in college. Bridgman

defined success as salary adjusted for the number of years of experience. In general, he concluded that rank in class, campus achievement, and early graduation, in that order, are significant indices of success in the Bell system. He acknowledged that he had no control for individual ability, although it should be noted that some people use rank in class as a proxy for ability.

Sometime later in a classic study of superior high school graduates, Dael Wolfle and Joseph Smith (1956) observed that, although there were substantial geographic differences among three regions studied, within each region, and for the three combined, those students who had ranked closest to the top of their high school classes reported the largest annual incomes. Since men were classified according to the education each received after finishing high school, it may be seen that the difference in income was greatest for the college graduates and less for those of lesser education. In a similar kind of analysis which used scores on an intelligence test rather than rank in class, Wolfle and Smith found that for men of a given range of intelligence, incomes were higher for those who had more education. Among men with the same amount of education, higher incomes went to those who had made higher scores on intelligence tests. The income differential associated with differences in intelligence, like that associated with differences in high school rank, was smaller than the differences associated with different amounts of education. Both sets of results from this study are suggestive of an interaction between years of schooling and individual ability, measured by scores on IQ tests or rank in class.

Wolfle and Smith also used their sample to analyze the effect of father's occupation on the probability of entering a profession. Regardless of their fathers' occupations, those who graduated from college were much more likely to be found in the professions than those who were not graduates. Among those who attained any particular academic level, however, there was little relation between father's occupation and the percentage in the professions. It is interesting to note that within each educational group, the sons of professional men had larger incomes than the sons of other men.

Although the studies by Bridgman and by Wolfle and Smith were limited due to the specificity of the samples, lack of data on important variables, and rather primitive statistical techniques (two-by-two classification tables rather than regression analysis), there were at least the seeds of the kind of analysis that is right at the forefront of the discussion of the relationships between educational inputs and educational outputs today.

A very impressive study was the doctoral dissertation of Shane Hunt (1963) at Yale University. Hunt used data collected by the Time Survey drawn from alumni records of nearly all the 4-year colleges and universities in the United States and including college graduates of all ages. Hunt used multivariate regression analysis to explain income of graduates by a constructed measure of ability from grades in college, extracurricular activities, socioeconomic background variables, years elapsed since graduation, and some purported measures of college quality, such as number of students enrolled and expenditures per pupil. Hunt determined that significance in the relationship between income and ability, experience, and size of college existed; however, less support for the argument that prestige of college affects income net of individual student ability was substantiated. Expenditures per pupil were a positive, relatively weak determinant of individual incomes. The study also looked at interactions among various income determinants by considering cross-product terms. Hunt's study brings into the discussion many of the qualifications and reservations that are necessary when generalizing results from a micro-economic data set. The work is even more impressive when we realize that almost all of the writing of the "human capital school" had not appeared at the time this study was undertaken.

Following the fundamental work of Becker (1964), Schultz (1963), and Mincer (1970), which established both theoretically and empirically the concept of expenditures for education, health, etc., as investments in human capital, a great outpouring of more or less sophisticated statistical studies looked at income-generating functions including measures suggested by the human capital approach. These studies have attempted to see the extent to which the relationship between years of schooling completed and income must be modified to account for the fact that people with different numbers of years of schooling have different innate abilities, different family backgrounds, and different quality of schools attended. A variety of studies on these topics is reviewed by Dael Wolfle (forthcoming). Also recommended for the reader's perusal are papers by Weisbrod and Karpoff (1968); Hines, Tweeten, and Redfern (1970); Reed and Miller (1970); Danier and Mechling (1970); Ashenfelter and Mooney (1968); Hansen, Weisbrod, and Scanlin (1970); Morgan and David (1963); and Rogers (1967). As Taubman and Wales (1972) point out, each of these studies suffers from one or more

of these serious problems: poor measures of education and ability; small and inadequate sample size; improper statistical technique; or too specialized a sample from which to form generalizations.

However, several studies have appeared in the last year or so which are not subject to most of these criticisms. Studies by John Hause (1972), Griliches and Mason (1972), and Taubman and Wales (1972) deserve a more detailed analysis. At least part of each of these three studies uses a sample of World War II veterans; and, hence, scores on the Armed Forces Qualifying Test are available for all members of the samples. The Hause and the Taubman and Wales sample was resurveyed in 1955 and 1969; it is a group of white males in the upper half of the ability distribution. The Griliches and Mason sample was followed up in 1964 and is a less exclusive group.

If education and ability are positively associated, then a measure of contribution of education to income that ignores the ability variable will be biased upward. Griliches and Mason (1972) investigated the magnitude of this bias by the estimation of income-generating equations containing measures of education with and without ability included. Including ability leads to another bias due to the correlation of ability with the quality of schooling variable, which is not included. This new bias is partially a function of the magnitude of the correlation between quantity of schooling and ability. Griliches and Mason solved the problem of this second bias by concentrating on that part of schooling occurring after or during military service, which turns out to be almost entirely uncorrelated with their measure of ability and, hence, is not subject to this type of bias. Moreover, since the intelligence test available in their data is administered prior to entering service, performance on it cannot be affected by the schooling increment after military service.

Griliches and Mason concluded there appears to be support for the conclusion of strong economic and statistical significance of schooling in the explanation of observed differences in income. Their results indicated a relatively low independent contribution of measured ability. Holding age, father's status, region of origin, length of military service, and the AFQT score constant, an additional year of schooling would add about 4.6% to income in their sample. At the same time, a 10% improvement in the AFQT score would add only about 1% to income. Taubman (1972) criticized the Griliches and Mason paper for several reasons. First, the authors did not attempt to discern any interactions among the various determinants of income. Second, the measure of IQ used apparently was not the optimal one according to Taubman's own work.

The paper by Hause (1972) certainly cannot be charged with ignoring interaction effects between ability and schooling. Hause suggested two hypotheses to be considered empirically. First, schooling and ability have a significant complementary effect on earnings:

> Let us suppose that schooling is measured in time units and that the opportunity cost of foregone earnings is a significant part of the investment costs of schooling. The strong, positive relationship between schooling attainment and measured ability suggests there is a greater incentive for persons of more ability to obtain more schooling. If the marginal products of ability and years are independent, it implies that people of low ability have a greater incentive to invest in schooling. The increase in earnings from an increment of schooling is the same for all, regardless of ability, but the foregone earnings are lower for those with less ability. This argument implies that the earnings function is misspecified, unless ability increases the marginal product of schooling. In fact, it requires that ability increase the marginal product of schooling on earnings rapidly enough to more than offset the rise in opportunity cost associated with higher ability up to the optimal level of schooling investment [p. S111].

Hause's second hypothesis was concerned with the effect of ability over time on earnings for a given level of educational attainment. Hause argued that there is no tendency for the coefficient on ability to attenuate with time, and there may well be a tendency for it to increase, especially at high levels of education. Behind this hypothesis lies the idea of abler people being more effective than less able in raising productivity through job experience, i.e., measured ability and learning in the labor force are complements in producing earnings.

Hause tested his hypotheses by looking at four different samples of data, but reported here are only the results from the NBER Thorndike sample because it is the same one used by Taubman and Wales. Hause sought evidence of interaction effects by running separate, within schooling-level regressions and also by looking at cross-product terms for the pooled sample. With the pooled sample, Hause regressed 1969 earnings on background variables, and AFQT test scores, years of schooling, and the product of the test scores and years of schooling. Despite multicollinearity among these variables, the coefficient on the interaction term appeared positive and significant, which supported the hypothesis that measured ability and educational attainment have significant complementarity. Hause's coefficients imply that the difference in earnings of college graduates with one degree who differ by one standard deviation in IQ is about $800, while the corresponding difference for high school graduates is

$250. It is interesting to note that when a pooled regression is run using the log of 1969 income, the interaction coefficient is again positive, although not highly statistically significant. Hause attributed this to the intercorrelation of these variables. When either the linear years or ability term was dropped from the regression, the remaining two coefficients were highly significant. Why this difference should occur between the linear and log forms of income is not completely clear. By comparing earnings functions using 1969 earnings and 1955 earnings, Hause revealed an increasing role played by ability over time. Hause also argued that the overstatement of rates of return to a college education compared with high school due to an understatement of ability-related opportunity costs did not appear to be a serious source of bias if ability data were unavailable. Burton Weisbrod's (1972) main criticism of the Hause paper was that it omitted taking into account the differences in motivations among individuals in the sample. Weisbrod also raised the question of whether the ability measure used is the proper one.

The paper by Taubman and Wales (1972) went somewhat further in analyzing the relationship between attainment of higher education, mental ability, and earnings. Taubman and Wales estimated earnings functions for two points in the individuals' life cycles 14 years apart. They tested for interactions among ability, school quality, and years attended; and, also, they looked for biases in the coefficient on years of schooling when ability is omitted. Taubman and Wales alleged that mathematical ability, not IQ, is indeed as important as education in explaining the range of earnings. The bias when ability was omitted was about 30% to 35% at various education levels for mathematical ability and only 9% for other types of mental ability. They alleged that mathematical ability is the most important type of mental ability for determining income, and they explained the low bias due to omission of an ability measure revealed in the Griliches and Mason paper by the fact that the latter used an improper measure of ability. Another reason for the variance in results may be due to the fact that Taubman and Wales used a sample of higher ability, and there is a positive interaction between ability and years of schooling. If average educational attainment in the Taubman and Wales sample is higher, then we would expect the impact of ability to be higher and also the bias from omitting ability to be greater. Finally, a detailed study of the other control variables (for example, socioeconomic background) used in the earnings functions in each paper would probably reveal other interactions and intercorrelations which would explain the direction of difference revealed by omitting ability.

To allow for nonlinear effects of ability, Taubman and Wales divided the variable into fifths, which they acknowledged may be closer to population tenths. They found that in 1955 those in the top fifth earned about 9% more and those in the bottom fifth 8% less than the average, while in 1969 the corresponding figures were 15% and minus 10%. Thus, over time, income of those in the top fifth had risen faster than the income of those on the lower end of the ability scale; and for those in the middle fifths, the growth rate has been about the same as that of the average high school graduate in the sample.

Interestingly, Taubman and Wales found practically no evidence of any difference in the effect of ability at various education levels in 1955, although they did find some evidence in 1969 that those in the fourth, and to some extent fifth, ability groups who had graduate training received more income from ability than those at lower educational levels. However, they found ability to be an important determinant of earnings even for high school graduates. They argued that Hause's finding of an interaction between ability and education was attributable to his selection of a restrictive functional form.

Taubman and Wales took a brief look at the effects of quality of schooling using a subjective academic rating known as the Gourman Index. They found that at the "some college" and "BA" levels only, the highest quality fifth affects earnings significantly, while for graduates, this is true for the top two undergraduate school fifths and the top graduate school fifth. Differences in income at a given educational level attributable to college quality effects appeared to be very large.

Taubman and Wales also made some estimates of the social rate of return to education. The most striking aspect of their results was the general decrease in the rates of return with increases in education, which held even though they had adjusted for large nonpecuniary rewards to precollege teachers who were concentrated in the BA, some graduate, and Master's categories. Compared with high school graduates with the same abilities and background, the social rates of return realized in their sample (before deflation) were 14, 10, 7, 8, and 4% for 2 years of college only, an undergraduate degree, some graduate work, a Master's degree, and a PhD. Rates of return calculated without standardizing for ability and background were generally about 20% higher.

So far the discussion has been centered around papers which tend to demonstrate that education increases incomes more or less, but the question of why education performs this function has been left unanswered. Welch (1971) has argued that in an era of rapidly changing technology, the more educated are more willing to innovate and more willing to take risks. Put more simply, if a new type of tractor is invented, one cannot expect it to be used by a farmer who is illiterate and cannot read the operating instructions, whereas an educated farmer would more easily be able to adopt the new technology. However, this explanation would tend to account for greater productivity of farmers or other individuals with some versus no education but would do less to explain the productivity of general (say, liberal arts) higher education. There are alternatives to the general argument that it is because education produces additions to an individual's cognitive or affective skills that it results in higher incomes.

A number of people have asserted that a primary role of education is to serve as a credential, particularly in highly paid managerial and professional occupations. As Taubman and Wales put it,

> To demonstrate that education is being used to screen people out of high-paying occupations, we must show that some people with low education are not in the occupation in which their marginal product and earnings are highest, but that highly educated people are allocated properly. If education is used to screen people, then the extra earnings a person receives from education are due both to the skills produced by schooling and to the income redistribution effect resulting from supply limitations.... There are several possible... [reasons why firms use education as a screening device] including snobbery and a mistaken belief in the true importance of education [pp. 18-19].

Taubman and Wales devised an ingenious test for the screening argument by estimating the predicted occupational distributions by education levels (given ability and other attributes) and by comparing that with the actual one. They found that people with less education are disproportionately underrepresented in the highly paying occupations.

A number of other recent studies have supported the screening argument. Ivar Berg (1970) has done a series of tests which he contended confirm the screening argument as well. Berg has observed that although the changing skill requirements between 1940 and 1965 for a large number of jobs were rather small, the educational requirements in order to get hired rose dramatically. He argued that there seems to be little relationship between changes in educational level and changes in output per worker. It appears that educational requirements have been rising much more than skill requirements in a large number of occupations.

Screening may be consistent with profit maximizing behavior, i.e., not merely the result of the (mistaken) belief that those with a degree are more productive. If successful performance in certain jobs depends upon individuals possessing a set of skills which would only be identifiable by expensive tests, firms might require a college degree if they believe that college graduates *on average* (or are more likely to) have the desired skills. Thus, to save on hiring costs and mistakes on the job, firms decide to use information on educational attainment, available at near zero cost, as a preliminary screening device. The case for screening can be either due to market failure arising from lack of knowledge or due to the high cost of obtaining knowledge. Of course it might be profitable to some firms if they acquired the testing mechanisms in order to properly ascertain the best people for certain jobs and, hence, to avoid the costs associated with screening by an indirect measure of productivity, namely, the college degree.

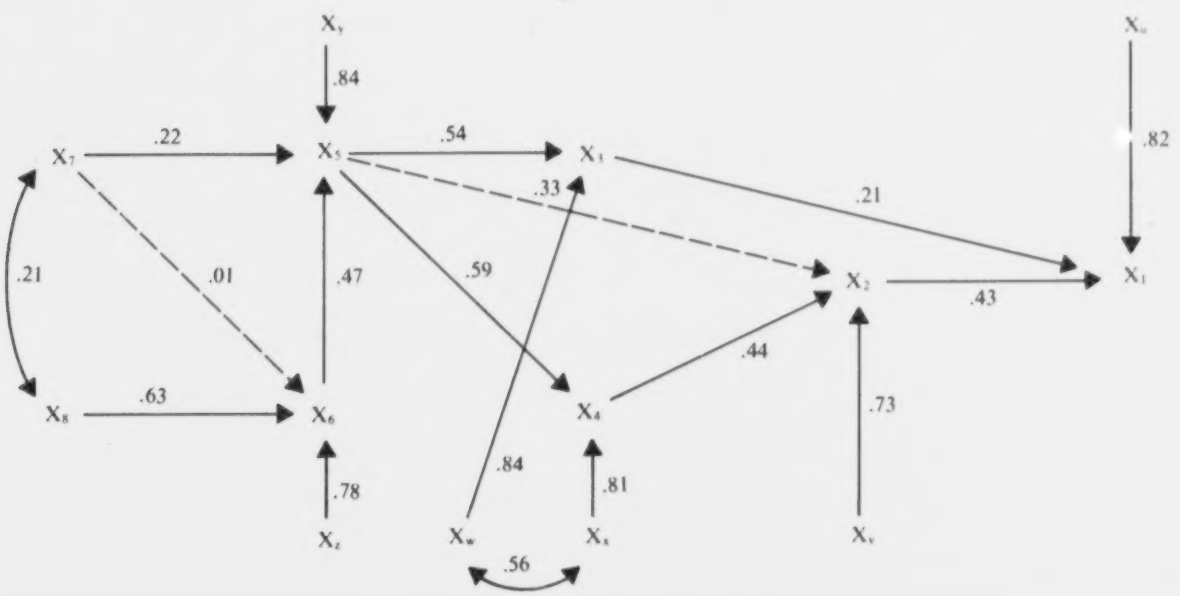
The screening argument says that employers are willing to pay more for more-educated rather than less-educated employees, even though their productivity differences do not warrant the extra pay or indeed extra occupational rank. In one way or another, these arguments rely on assertions of market imperfections. The question immediately arises of why some employers do not move into the breach and hire less-educated, but equally skilled workers, at lower salaries and thereby make greater profits. Perhaps the answer is that productivity is being improperly measured. The extra value of the more highly educated employees might not be recognizable as differences in physical output but might be present nevertheless; perhaps more educated people generate "goodwill."

While economists have been asking questions about the contribution of education, ability, and school quality to income, and indeed what it is about education that makes it productive, several centers of sociological research have been asking quite similar questions, concentrating more on the effects of background variables. In particular, considered here is some of the work under the general supervision of Otis Dudley Duncan at the University of Michigan, William Sewell at the University of Wisconsin, and James Coleman at Johns Hopkins. Much of their work has attempted to explain differences in occupational status by well-conceived measures of family background (socioeconomic status), individual ability, and years of schooling. It is apparent that the correlation

between occupational status and income is very high. According to Blau and Duncan (1967),

> The multiple regression of percent "excellent" or "good" prestige ratings on the education and income measures was calculated. The multiple correlation, with forty-five occupations as units of observation, came out as .91, implying that five-sixths of the variation in aggregate prestige ratings was taken into account by the combination of the two socioeconomic variables [p. 120].

There is a reference to the classic work of Blau and Duncan in the first sentence of each of the three papers explaining occupational status, which shall be discussed. The Blau and Duncan model begins with two variables describing the early stratification position of each person—his father's educational and occupational attainment statuses. It then moves to two behavioral variables—the educational level the individual has completed and the prestige level of his first job. The dependent variable is the person's occupational prestige position somewhat later. The model accounts for about 26% of the variance in educational attainment, 33% of the variance in first job, and 42% of the variance in 1962 level of occupational attainment. In two papers, William H. Sewell and several (different) associates (1969, 1970) extended the original Blau and Duncan framework to apply social psychological concepts to the explanation of variation in levels of educational and occupational attainment. In particular, they added to the model measures of mental ability and also measures of the influences of others on the individuals being studied. Figure 1 presents the most likely of the causal linkages in the Sewell model. In it straight, solid lines stand for causal lines that are to be theoretically expected; dotted lines stand for possible, but theoretically debatable, causal lines; and curved lines represent unanalyzed correlations among variables which cannot be assigned causal priority in the present data. A more refined version of this diagram is presented in the second Sewell et al. paper (1970), but in general the values of the coefficients are approximately as hypothesized in Figure 1.



X_1 - Occupational Attainment
X_2 - Educational Attainment
X_3 - Level of Occupational Aspiration
X_4 - Level of Educational Aspiration
X_5 - Significant Others' Influence
X_6 - Academic Performance
X_7 - Socioeconomic Status
X_8 - Mental Ability

Fig. 1. Path coefficients of antecedents of educational and occupational attainment levels (from Sewell et al., 1969, p. 85). Reprinted by permission.

It appears that significant others' influence (SOI) was of central importance. SOI has direct effects on the level of educational and occupational aspirations, as well as on educational attainment. In turn, each aspiration variable appears to have substantial effects on its respective attainment variable. SOI is affected directly by socioeconomic status and indirectly by measured ability through the latter's effect on the youth's academic performance. The variables used accounted for 34% of the variance in the level of occupational attainment and 50% of the variance in the levels of educational attainment. These R^2 were higher than those obtained in economists' earnings function estimates. The reason for this probably is that, although one can account for occupational attainment and educational attainment by a prescribed group of variables, translating of occupational status and education into dollars is a more uncertain procedure. Things like luck and other random events have a lot more to do with income earned than with education achieved or even occupation entered. Also, the background variables are better specified in the sociological studies.

It is interesting to note that if SOI is an important factor in occupational attainment and educational attainment, external agents might intervene to change educational and occupational attainment levels. SOI is clearly a variable amenable to manipulation. The results seemed to indicate also that aspirations are in fact performing mediational functions in transmitting anterior factors into subsequent behaviors.

The Sewell data (1969) began with a survey of 1957 high school seniors in Wisconsin but included only those who responded to a follow-up questionnaire in 1964, who were male, and whose fathers were farmers in 1957. This leaves us with under 1,000 cases. The standard question of how representative this sample is can be raised, but one probably should not worry about this too much.

The work of the paper by Sewell et al. (1969) was revised somewhat in 1970 using the more complete Wisconsin sample. The first study entered education as a variable indicating whether or not the respondent had attended college. The second study used a four-way classification—no post-high school education, vocational school, college attendance, and college graduation. The main difference in the second study is that for the revised model, educational attainment has a greater effect on occupational attainment, while the level of occupational aspirations has slightly less influence on occupational attainment. Of course the reason for this is probably the more precise measure of educational attainment. Certainly a more refined education variable would have had even more power.

The two Sewell papers add significantly to the knowledge regarding the role of variables that mediate between such predetermined variables as social class origins and measured ability and such outcome variables as educational and occupational status attainments. However, variables in the system other than educational attainment contributed only moderately to occupational attainment. This result suggests that additional research is needed to find other influences on occupational status attainment. Perhaps factors tied to a person's marital status might help. These have proved significant in the economists' earnings functions.

The second paper confirmed the critical role of significant others' influence in the status attainment process but also added that academic performance has effects on aspirational and attainment variables that are not mediated by significant others' influence. The second paper looked at the model broken down by type of residence and demonstrated that the model has been found to be appropriate for young men from a variety of urban and rural residential backgrounds. However, the model's adequacy for very large cities needs to be established. Finally, it should be noted that no women were included in this sample and only a very small number of blacks.

The work by Coleman, Blum, and Sorensen (1971) attempted to explore the relationship between the status of the first full-time occupation held by a male and the status of his occupation 10 years later. They focused on intervening labor force experience as well as on events in other realms of the individual's life. In particular, Coleman et al. wanted to look at differences in black and white occupational changes.

Regressions to explain first-job status showed several things. First, for both blacks and whites, far outweighing all else was the importance of the respondents' educational attainment. Second, it was more effective for job status for whites than for blacks. The increment of occupational status associated with a unit increase in educational attainment was almost twice as great for whites as for blacks. Thus, blacks suffered educationally in two ways: First, their level of educational attainment was lower; and second, a unit increase in educational attainment showed less than half the benefits in occupational status that the same increment in education brought for whites. They acknowledged that the quality of education available to the two

groups had been quite different. Most of the effect of parental background took place through educational attainment, rather than apart from it. However, for both blacks and whites, the occupational status of the father showed some independent effect. The authors also attributed some of the differences between blacks and whites to discrimination. In this case, race was used as a screening device rather than (or in addition to) the use of college graduation, as alleged by Taubman and Wales and by Berg.

In the analysis, the authors found a correlation of .506 for whites and .395 for blacks between status of first job and status of job held 10 years later. Interestingly, a striking number of variables had a larger zero-order correlation to second job for whites and a smaller one for blacks. It appears that family background, as represented by father's occupational status, was still quite important for job growth for whites but much less so for blacks. The major effects were from first-job status and educational attainment, with the latter being much more powerful.

The evidence that the effects of certain characteristics persist or become even stronger 10 years after entering the labor force as compared with their effects in the initial job are consistent with the human capital theory of income determination (Mincer, 1970). All factors bearing on an individual's potential for income or occupational status do not come into play immediately when that individual enters the labor force. Many people decide to forego occupational status or income when accepting a first job, particularly in order to obtain further training on the job. If it is the more qualified individuals who forego status in income in order to obtain on-the-job training, then it will only be after a number of years, when returns not only to the factors possessed when entering the labor force but also to on-the-job training take effect, that the true differentials in occupational status or income will be realized.

This paper then looked into factors intervening between status of the first job and status of the later job. It appeared that additional educational activity constituted the most important of these intervening events. For whites, the occupational activities were second, while for blacks it was the events in the marital and family sphere. This greater importance of the marital sphere for blacks' occupational status has been suggested by two results: first, the strong relationship of first-job status to wife's education and now the greater contribution to explained variance by a set of marital and family variables. Interestingly, intervening events seemed to have a greater effect in terms of being translated into occupational status for blacks than for whites, although background factors showed greater efficacy for whites. The dominance of educational attainment in influencing occupational status did not preclude the possibility that parental background exercises a major indirect effect through its effects on the educational level. However, its direct effects in establishing initial occupational status were not great.

In assessing the differential impact of levels of education and other background characteristics on initial occupational status, it is possible to determine the proportion of the overall difference in status level due to different levels of background resources and the proportion due to different efficacy of resources in establishing occupational status. Results indicated that 58% of the observed status difference between blacks and whites was due to differences in the levels of background resources brought to the labor market, and 32.5% was due to differences in the efficacy of these resources in producing high occupational status. The analysis of later job status showed that whereas the initial status difference between the two groups was 5.59 status units, it had widened to 10.95 units by the end of 10 years. They found that approximately half of the difference in status change was due to the differences in the levels of resources and activities that bring status. About half the difference in later job status was unexplained either by different levels or by different efficacy of those resources measured. Perhaps on-the-job investment might be helpful to consider here.

Otis Dudley Duncan (1969) helped direct sociologists into using income as the dependent variable when he asked in 1968 whether black-white income differences were due to inheritance of poverty or inheritance of race. He estimated different path and regression coefficients for blacks and whites. He concluded that the Negro has a double handicap. First, the Negro begins the life cycle typically with characteristics that would be a disadvantage to anyone, white or Negro—specifically, low levels of parental socioeconomic status. Second, achievements at subsequent stages of the life cycle cannot be capitalized on as readily. This is consistent with the Coleman results reported previously. Duncan observed that the black-white income gap was $3,790, and family background differentials accounted for just one-quarter of this amount or $940. The disadvantage to Negroes from having a large

number of siblings provided a handicap which, if eliminated, would increase income by $70 per annum. Furthermore, the educational gap would account for $520 of the $3,790 difference actually observed, less than one-seventh thereof. Of course, this measures education in number of years rather than in terms of some quality-adjusted measure. Variables discussed so far accounted for 12.0 of the 23.8-point occupational gap, thus attributing roughly half of it to educational differences, family size, and family background. The remaining 11.8 points are not otherwise explained by the model, and Duncan labeled this "occupational discrimination." This can be converted into $830 or one-fifth of the total dollar gap. Occupational discrimination was due to the fact that Negroes equally well-educated as whites and originating in families of comparable size and socioeconomic level did not have access to employment of equal occupational status. However, $1,430 was the difference between Negro and white incomes that could not be attributed to differential occupational levels, differential educational attainment, differences in family size, or socioeconomic status thereof. This Duncan called "income discrimination." Duncan concluded that inheritance of poverty was less important than discrimination per se. He did not worry about incorporating school quality variables because he argued they would be related to years of education attained.

Duncan further argued that about one-quarter of the gap in mental ability scores was attributed to Negro-white differences in family socioeconomic level and number of children. The remaining three-quarters of the gap must be attributed to other factors which can perhaps be summed up as differential mental development. Although the introduction of mental ability into the model allows us almost fully to account for the educational gap, the same is not true with regard to occupation and earnings. He concluded that discrimination still explains a large part of black-white income differentials.

Samuel Bowles (1972) has recently argued that the relatively small explanatory power of socioeconomic background is due to the fact that this concept has been improperly measured. Moreover, he questioned studies which seem to show that extra schooling exerts a major effect upon earnings or occupational status independent of the social class background of the individual. Bowles argued that the misspecification of socioeconomic status is due to the omission of parental income or wealth; the usual measures of occupational status come from father's occupational status and father's education.

Bowles's study [using the same data as Blau and Duncan (1967), from a U.S. Census Survey] revealed that family background measures explain 52% of the variance of years of schooling obtained by the respondent. Also, years of schooling attained appeared to be a significant determinant of earnings of the members of his sample. This partial relationship of schooling to income net of socioeconomic background was less than 60% as large as the gross return indicated by the simple relationship between the two variables. He concluded that this finding suggests that much of the apparent economic return to schooling is, in fact, a return to socioeconomic background. Moreover, the variance of earnings explained by social background variables alone is only slightly less than that explained by these variables along with educational attainment of the respondent. Bowles concluded that years of schooling attained exerts a comparatively minor independent influence on earnings independent of social background.

The Bowles results seemed to be different primarily because of the different measure of socioeconomic status he used. However, there was clearly a high correlation between the traditional measures of socioeconomic status (SES), namely, the father's educational attainment and occupational status, and family wealth. Moreover, the R^2 obtained by Bowles was not much greater than that obtained in the traditional earnings functions in which occupational status and educational attainment of the father are used.

Becker (1972) acknowledged that family background is one of the most difficult variables to measure, since it is based on student recall of parental conditions some time earlier. However, properly measured family background may increase *or* decrease the power of other variables. Becker felt that Bowles had overstated the effect of background compared to own education by referring to the addition to R^2 when education is added after family background. Sociologists have argued that this *is* a legitimate test, since background did occur *before* schooling. Bowles ignored effects of post-school investment and, in particular, its positive correlation with years of formal schooling.

Becker pointed out that a major effect of family background comes through a mother's preschool and other nonschool investments in her children. Mother's education probably is more important than father's in influencing productivity of children. Also,

a wealtny home facilitates financing of foregone earnings and other school costs.

Hauser, Lutterman, and Sewell (1971) recently attempted to relate socioeconomic background and the earnings of high school graduates, using the Wisconsin sample noted previously. They have moved occupational status to an intermediate position. Consistent with the human capital theory and the results from the Coleman paper previously reported, Hauser observed an increasing stabilization of earnings capacity with respect both to social background and to one's own educational and occupational achievements with increasing labor force experience. The authors found that the effect of education on income was reduced by 19% when ability was entered as an additional explanatory variable. This finding is more in line with the conclusion of Taubman and Wales than that of Griliches and Mason. Hauser, Lutterman, and Sewell compared their results with those using other data sets and found that the interpretation they put on the education, occupational status, and earnings relationship was quite similar. They also did some tests which confirmed the validity of their assumption of a linear model.

It will be worthwhile at this point to summarize the results of the most complete model used in this paper:

> Each socioeconomic background variable (related to the mother and to the father) has a modest direct effect on ability, while ability has a large effect on educational attainment. The direct effects of each background variable on educational attainment are essentially equal in size and about as large as their effects on ability. Educational attainment has a very large direct effect on occupational status, which is also directly influenced by father's occupational status and by ability. That is, students with equal educational credentials are slightly better off in the job market if they are unusually bright or if their fathers had unusually good jobs. However, mother's and father's educational attainments and incomes have no influence on one's occupational achievement beyond their influence on ability and educational attainment. Finally, in the determination of earnings, ability and educational attainment have modest and roughly equal effects while the effects of occupational status and parental income, also roughly equal in size, are about twice as large as those of ability and educational attainment [p. 31].

The authors emphasized the effect of parental income on earnings of young men: it is as large as the effect of their achieved occupational status. Their important finding of direct social inheritance of earnings capacity is consistent with the finding from the Bowles (1972) paper. The family confers a modest economic advantage or disadvantage which is independent of ability, educational attainment, or occupational achievement.

It appears that father's education is an important determinant of a child's schooling. However, the use of income as the final dependent variable in the path analysis has revealed the greater power of parents' income as a direct determinant of child's income. Recent work has elucidated the proper roles of various aspects of family socioeconomic background.

To summarize this review, one might start by asserting that many economists and sociologists have been seeking answers to the same question. All have been seeking to explain later-life success (and differences in success) by education, individual ability, and background considerations. Perhaps the sociologists have worried more carefully about the exact nature and specification of the background factors. The economists have worried considerably about the proper role which should be attributed to investments in human capital as represented by formal schooling. In general, the attempt has been to unravel the interrelationships between the three sets of important variables. Throughout this review, it has been apparent that investment in schooling has generally been measured by years completed. Every so often there is a reference to the fact that different returns to different amounts of schooling might indeed be due to differences in quality of schooling. A few studies which have attempted to measure educational quality have used as output measures changes in students evident immediately upon leaving college. One further extension of the kind of analysis surveyed so far is the introduction of precise measures of school quality into the earnings relationship.

The Definition and Impact of College Quality

The author's work attempts to add a new dimension to the earnings function analysis by hypothesizing the features of colleges which might yield financial payoffs in later life to those who attend and then by testing to see which of these traits actually do add most to the explanatory power of the traditional earnings function.

Two general types of attributes of colleges can be isolated and measured (if imperfectly). They are as follows:

1. *Student Quality*. The argument is that a student benefits more from college and hence acquires

more of whatever colleges give that enhances future earning power when surrounded by high-quality fellow students. This has been called the peer effect. Intuitively, it does seem that the opportunity to interact with intelligent and motivated peers should enrich the college experience. There are several measures of average student quality by schools: the average Scholastic Aptitude Test (SAT) scores of entering freshmen[2] and an index of intellectuality of students obtained by Alexander Astin through factor analysis.[3] Another variable which has been developed by Astin, an index of selectivity based upon the average SAT scores of entering freshmen, is also used as a dimension of quality.

2. *Instructional Quality.* The second aspect of college quality is the excellence of faculty. The hypothesis here is that better faculty instill in students traits which will be beneficial in subsequent years. One measure of faculty quality is average faculty salary.[4] The assumption is that higher paid faculty have either more experience (and higher rank), better teaching ability, more professional prestige from research, or greater opportunities to earn elsewhere, all of these being indicators of greater productivity in their professorial roles.[5] Another measure of school quality is school expenditure for instruction, research, and library per full-time equivalent student. Here, the argument is that high-quality faculty are attracted by expenditures beyond those on salaries alone. Also, holding these expenditures per faculty member constant, a larger expenditure per student implies a greater teacher/student ratio.[6] Thus, this measure is a test of the influence of teacher/student ratios as well. The hypothesis is that the first derivatives of both expenditures per faculty member and faculty per student with respect to quality are positive.[7] Unfortunately, data of this kind ignore differing definitions of "full-time faculty" at different colleges. Teaching loads range from one course to four or more per semester at different colleges, and these differences may alter teacher effectiveness. Other problems with this proxy for quality arise since it allows for no nonpecuniary attractiveness of particular colleges for particular faculty members. Schools located in undesirable areas (urban ghettos with high crime rates or isolated rural areas with no cultural life) may be forced to pay high salaries for even mediocre-quality faculty. Schools with attractive surroundings (scenery, a few top scholars, cultural life, or exceptionally good research and teaching equipment and plant) may be able to attract high-quality faculty for low salaries. Low salaries may be paid to top-quality faculty where opportunities for lucrative outside consulting jobs abound. Of course, students may or may not get benefit from "good" faculty who are away consulting much of the time. In any case, the hypothesis that is tested here is that schools which pay large salaries to faculty members who meet relatively small groups of students are more beneficial to students' subsequent earning power than those schools which pay low salaries or have large classes.

A related quality measure refers to the total incomes or expenditures per student of the colleges. It might be argued that schools which spend (or receive) larger amounts per enrollee provide a higher quality education, an educational experience more beneficial in post-school years.

A subjective measure made by Gourman (1967) is an additional test of school quality. These ratings propose to be a "consensus of reliable opinion and judgment obtained from many and various sources deemed to be dependable and accurate [p. ii]." The study evaluates individual departments as well as administration, faculty, student services, and other general areas such as library facilities. An average of all items is calculated, resulting in an overall Gourman Index between 200 and 800. The interpretation of these ratings depends upon the weights given to the various criteria. Unfortunately, these weights are not published. However, the index is one of the few quantitative ratings of a large number of colleges.

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[2]Of course an individual's IQ will be highly correlated with his SAT scores. However, here we are looking at the effect of *average* SATs of *all* students at a college on an individual's subsequent income, controlling for the individual's IQ.

[3]J. Cass and M. Birnbaum, *Comparative Guide of American Colleges*, Harper and Row, 1969, gives SAT scores; A. Astin, *Who Goes Where to College?*, Science Research Associates, 1965, gives the intellectuality and selectivity indices.

[4]AAUP, "The Economic Status of the Profession," *AAUP Bulletin* (Summer 1964). Data are for 1963-64.

[5]One might ask about the relationship between these traits and academic salaries and also which of these have more important effects on students' later incomes. However, data limitations enable us here only to look at the gross relationship between faculty salaries and student incomes.

[6]This is true if one assumes contact hours per faculty member are constant. Obviously:

$$\frac{\text{Exp.}}{\text{Stu.}} = \frac{\text{(Exp.)}}{\text{(Fac.)}} \times \frac{\text{(Fac.)}}{\text{(Contact Hrs.)}} \times \frac{\text{(Contact Hrs.)}}{\text{(Student)}}$$

[7]Quality can be thought of as attributes of colleges which increase learning which, in turn, makes students able to earn larger incomes in later life.

There is a question of whether or not all the measures of quality are really standing for the same thing. Table 1 presents correlations between pairs of college attributes. In general these exceed .5.

Table 2 presents regressions with individual colleges as units of observation. These enable us to consider the relationships between the nonmonetary quality measures and the expenditure data and school size. It is obvious that the nondollar quality measures are significantly influenced by expenditures as a whole, faculty salaries, and size of student body. Size is negatively related to average SAT scores and the Astin measures, i.e., better peer group influences apparently are found in smaller schools. Gourman ratings are positively influenced by size. Interestingly, about 50% of the variance in the peer group measures is explained by our model, but 70% of the Gourman ratings is explained.

Empirical Estimates of Earnings Functions with Quality Variables

For those with 13 or more years of schooling, the following equation was estimated:

$\ln Y^{69} = a + b\,YRS + c\,EXP + d\,EXPSQ + e\,IQ + fZ.Q_{UG} + g\,Q_{GRAD} + h_iV_i + u$, where ln Y is log of 1969 earnings, YRS is years of education, EXP is years of experience in the full-time labor force (years since first job), EXPSQ is the squared value of EXP to take account of the nonlinear influence of on-the-job experience on earnings, IQ is a measure of the level of ability (presumably affected by a combination of genetics and environment). The quality measure used is that for the *last* college attended by the respondent. This particular form of the quality variable was selected since it appeared in preliminary work that those who went to more than one college (for example, graduate school) had incomes affected primarily by the nature of their final college. Hence, Z = 1 if years of education was 13 to 16 inclusive and 0 otherwise, Q_{UG} and Q_{GRAD} are measures of undergraduate and graduate college quality respectively, and V_i are several occupational dummies. The occupational dummies were particularly necessary since teachers are traditionally paid less than other people with the same education and doctors receive more.

For some regressions, a *single* variable—quality of the last college—was devised as the Q_{UG} for those not going on, and Q_{GRAD} for those with more than 4 years of college. This enables a single average "income elasticity" of college quality and ignores different payoffs to quality depending upon years. This is somewhat less cumbersome to deal with than two separate variables, although it will be seen that the quality coefficients do differ depending upon attainment.

The data used are the NBER-Thorndike sample which has been described in detail in several other places.[8] The respondents were white World War II veterans, all of whom took a battery of aptitude tests in 1942 to determine if they were qualified to be pilots.[9] To take the test, one had to have above-average IQ and be in good health. Those willing were surveyed by Thorndike in 1955 and by the National Bureau of Economic Research again in 1969. They provided much information on earnings history, socioeconomic situation, and educational experience, including name(s) of college(s) attended, as well as aptitude test scores.

The question arises whether the sample was biased since only those who attended schools where quality data were available were in the sample. Biases would exist if one particular quality of school refused information. At first glance, one might predict that schools of low quality would be the ones reluctant to report. However, this is not generally true. Many schools provide the services of granting college educations and degrees to high school graduates who are not qualified to enter schools generally considered to be high-quality institutions. It is in the interest of these low-quality schools to become known by less-qualified college aspirants. On the other hand, a number of schools with "good reputations" may be reluctant to report statistics for fear of revealing quantitative evidence that their reputations may not be fully justified. Hence, there appear to be reasons why both high- and low-quality schools would not report. Some schools may have other reasons, unrelated to quality, for not reporting. For example, some schools only require SAT scores from lower-quality applicants (those graduating in the bottom 75% of their high school classes must report SAT scores but not those in the top 25%). Some schools might not feel that their available data are relevant, as when most faculty members are only part-time employees of the college. Other schools might not want to take the time to compute the data desired. There is no reason why these nonreporters

[8]For example, Taubman and Wales (in press).

[9]The IQ variable used is a combination constructed by factor analysis of several of the AFQT tests and has a mean of .30 and a standard deviation of 1.86.

TABLE 1

Correlations between the Various Attributes of Colleges (Colleges as Observations)

	2[a]	3	4	5	6	7	8	9	10	11
1. Average faculty salary	.6295	.6540	.7460	.6870	.7364	.8016	.7746	.6141	.6530	.2535
2. SAT verb.	——	.9069	.5603	.5649	.6101	.5888	.5545	.6592	.7667	-.0978
3. SAT math.	——	——	.6068	.6093	.6613	.6169	.5927	.7205	.7758	-.0988
4. Dept. res. inst. and libr. exp.	——	——	——	.8178	.9555	.7540	.7262	.6247	.6312	.0482
5. Basic income	——	——	——	——	.8413	.6738	.6390	.5977	.6193	.0211
6. Basic expenditures	——	——	——	——	——	.7127	.6764	.6576	.6759	-.0803
7. Gourman overall	——	——	——	——	——	——	.9827	.6674	.6976	.3084
8. Gourman academic	——	——	——	——	——	——	——	.6615	.6811	.3318
9. Astin intellectuality	——	——	——	——	——	——	——	——	.7399	.0114
10. Astin selectivity	——	——	——	——	——	——	——	——	——	.0182
11. 1960 enrollment	——	——	——	——	——	——	——	——	——	——

[a]These numbers refer to the numbered attributes at the left of the table.

TABLE 2

Regression Relationships among Quality Variables

	SAT		Gourman		Astin	
	Verbal	Math.	Overall	Academic	Intell.	Select.
Constant	339.9	355.1	94.9	97.5	28.1	31.0
Basic expenditures (per student)	.0149 (2.4495)	.0232 (3.7548)	.0491 (6.8916)	.0495 (6.1135)	.0055 (5.4403)	.0045 (5.2771)
Undergraduate enrollment	-.0039 (-4.0248)	-.0036 (-3.6735)	.0063 (5.5849)	.0075 (5.8327)	-.0001 (-.5674)	-.0001 (-.8106)
Average faculty salary	.0031 (6.7456)	.0200 (6.4415)	.0269 (7.5304)	.0274 (6.7516)	.0019 (3.7439)	.0020 (4.7070)
Adj. R^2	.4740	.5206	.7114	.6700	.4629	.5043
Mean qual.	540.8	563.7	442.5	454.4	54.01	56.02
S.D.	60.99	64.87	96.4	102.4	10.1	8.8
Coefficient on basic expenditures when used alone	.0474	.0547	.0876	.0882	.0085	.0075
Adj. R^2	.3694	.4348	.5058	.4551	.4299	.4544
Coefficient on expenditures for Library, Res. and Inst. when used alone	.0724	.0834	.1541	.1576	.0134	.0117
Adj. R^2	.3109	.3654	.5665	.5253	.3875	.3958

Note.-226 schools with all data are the units of observation.

should fall into any particular quality group, and the evidence confirms this.[10]

A potentially more serious problem with the quality data is that most of the information on schools is for the post-1960 period whereas the respondents attended around 1950. Unfortunately, earlier data on colleges are not available. The assumption is that the correlation of college quality is unchanged over time. This assumption is probably not too bad, particularly in a gross sense (good schools are still good, but the ranking of the good schools might vary somewhat). One can view the differences over time as a random measurement error.

The only data available over a reasonable period of time are those on average salary. Data for 36 schools were made available to the researchers for the years 1939-40, 1953-54, 1959-60, and 1969-70.[11]

Several tests were performed and these revealed significant serial rank correlation. Analysis of variance revealed that the variation of rank across schools was significantly greater than the variance of rank of a school over time.[12]

Material following will show that the quality measures for later periods are highly correlated with earnings of those who attended earlier. One is tempted to argue that if quality measures for the more relevant year were obtainable, these would reveal an even stronger relationship with earnings. However, the question of effects of college quality is too important to put aside on the grounds that current data are imperfect.[13]

Table 3 provides the estimation of earnings functions with different quality measures. It appears that regardless of how quality is measured, the traits of one's school significantly affect log of subsequent earnings (i.e., log of 1969 earnings). These effects are after controlling for the individual's IQ, years of education, and experience. The t-values on quality (10 measures) range from 3.744 to 6.049 with 1,506 degrees of freedom. Here a single variable is used—the quality of the last college attended (graduate or undergraduate where appropriate).

One should pause at this point to note that the coefficient on years of schooling is only slightly over .03 in all the earnings functions of Table 3. These coefficients should *not* be interpreted as the rate of return to years of education. According to the theory of human capital, the rate of return to years of schooling equals the coefficient on years, r, times $\frac{1}{k}$ where

$$k = \frac{\text{Actual opportunity cost plus direct costs}}{\text{Annualized opportunity costs}}$$

Hence, the coefficient on years is the (private) rate of return only if k equals 1. If direct costs equal student earnings, exactly 100% of potential income would be invested in obtaining human capital, k would equal 1, and r would be the rate of return.

The sample contained people who almost always went to college under the GI Bill of Rights. These students had no direct costs of schooling and received subsistence payments as well. As an approximation it was assumed that, as students, the sample members received $100 per month plus tuition under the GI Bill.[14] From the 1950 Census one can deduce that a white high school graduate aged 25 to 29 earned $3,008 per year on the average.[15]

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[10]The colleges remaining in our sample range from the very top to the very bottom of each of the quality measures. However, the 1,511 individuals left for our study appear to have somewhat higher incomes, years of schooling, and ability than the full sample with 13 or more years.

[11]These were obtained through the generous cooperation of Mrs. M. Eymonerie of the American Association of University Professors, Washington, D.C. The 36 schools were not identified specifically but represent a cross section of American colleges.

[12]The F-ratio was 12.43 and the critical F for the given degrees of freedom for significance at the 1% level was 1.99.

[13]It has been suggested that if graduates from certain colleges earned high incomes for reasons unrelated to the quality measures, they might have *subsequently* donated large sums to their alma mater. This would have enabled colleges to then obtain high marks in the quality measures. In this case, high incomes supported high quality. Moreover, high current incomes might be due to current prestige of one's alma mater regardless of the quality during the time attended.

[14]President's Commission on Veterans Payments, *The Historical Development of Veterans Benefits in the U.S.* (Washington, D.C.: Government Printing Office, 1956), p. 156. The Servicemen's Readjustment Act, known as the GI Bill of Rights passed in the 78th Congress in 1944, paid up to $500 per year tuition plus $50 per month with no dependents or $75 per month with one or more dependents. In 1945 the monthly payments with one or more dependents were raised to $90 and in 1948 were raised to $105 with one dependent and $120 with more than one dependent.

[15]Census of Population, 1950, Special Report P.E. No. 5B, *Education* (Washington, D.C.: Government Printing Office, 1953)

TABLE 3

Earnings Functions with Different Aspects of College Quality

	Gourman overall	Gourman academic	Average salary	SAT Verbal	SAT Math.	Inst. dept., res., and library expenses	Basic income	Basic expenditures	Astin intell.	Astin select.
Constant	1.722	1.720	1.512	1.340	1.264	1.859	1.847	2.036	1.517	1.403
	(9.970)	(9.939)	(8.366)	(6.781)	(6.256)	(11.00)	(10.87)	(11.78)	(8.359)	(7.233)
IQ	.03536	.03560	.03232	.03357	.03209	.03431	.03556	.03543	.03252	.03355
	(4.911)	(4.946)	(4.467)	(4.634)	(4.418)	(4.745)	(4.913)	(4.859)	(4.487)	(4.629)
Years of education	.03142	.03174	.03052	.03420	.03473	.03176	.03370	.02448	.03147	.03327
	(4.347)	(4.347)	(4.198)	(4.750)	(4.838)	(4.356)	(4.632)	(3.000)	(4.337)	(4.600)
Experience	.03523	.03573	.03927	.03441	.03454	.03667	.03430	.03657	.03649	.03479
	(2.630)	(2.665)	(2.935)	(2.571)	(2.584)	(2.736)	(2.554)	(2.716)	(2.729)	(2.598)
Experience^2	-.0008265	-.0008403	-.0009354	-.0008216	-.0008233	-.0008651	-.0008042	-.0008622	-.0008708	-.0008167
	(-2.506)	(-2.547)	(-2.839)	(-2.495)	(-2.502)	(-2.622)	(-2.433)	(-2.601)	(-2.645)	(-2.478)
Quality of last college attended	.0005812	.0005576	.0004822	.001189	.001259	.0001324	.00008250	.00004069	.008721	.01011
	(5.124)	(5.047)	(6.049)	(5.520)	(5.778)	(5.175)	(4.373)	(3.744)	(5.808)	(5.297)
R^2_5 (5th step)	.07632	.07584	.08251	.07885	.08060	.07663	.07199	.06887	.08080	.07740
R^2_4 (4th step)	.06020	.06020	.06020	.06020	.06020	.06020	.06020	.06020	.06020	.06020
Quality mean	519.664	538.447	10339.5	555.124	576.404	115.108	1877.32	2270.97	580.304	59.5592
Elasticity	.3020	.3002	.4985	.6600	.7256	.1524	.1548	.0924	.5060	.6021
ΔR^2	.01612	.01564	.02231	.01865	.02040	.01643	.01179	.00867	.02060	.01720

Note.- R^2_4 is the R^2 after the fourth step (only YRS., IQ, EXP and EXPSQD).

R^2_5 is the R^2 with all five variables including quality.

ΔR^2 is ($R^2_5 - R^2_4$) and is the additional explanatory power.

This was assumed to be the foregone earnings of people in the sample. Hence, it appears that k equaled roughly .35106 and $\frac{1}{k} = 2.85$.[15]

In order to estimate rates of return to years in college, one should multiply the years coefficient by 2.85. The rates of return appear to be roughly 9.7%. Becker estimated the returns to a white male college graduate to be 13% in 1949.[17]

There are several reasons why the present estimates were below those of others. First, the sample included only people who have at least some college education; and so, the coefficients reflected the return to an extra year of college *not* the return to college training compared with the return to high school attendance. The second reason for the low rate of return to higher education was the preponderance of teachers in the sample. Teachers have high education and relatively low annual earnings. Finally, an examination of the dropouts in the sample indicated that they were usually pulled out of school by good earnings opportunities, not pushed out due to poor achievement.

Another reason for the apparent low payoff to extra "raw years" in school was that there were controls for college quality. It is probably the case that those with more years also attended higher quality institutions.[18] Thus, part of the return to extra years

[15]Assuming a 9-month school year,

$$k = \frac{3/4 \times 3008 - 1200}{3008} = .35106$$

[17]G. S. Becker (1964). Of course Becker acknowledged the crudeness of the estimate.

[18]The correlation between years and quality of the last school attended was about .25.

was reflected in the returns to quality rather than returns to years. The coefficient on years rose to slightly over .04 when quality variables were omitted from the earnings function, and this would imply a rate of return to years not controlling for quality of about 12%. Of course, the ability variable also detracted from the coefficient on years since there was a positive relationship between innate ability and educational attainment.[19]

After establishing that quality is important, however measured, the task of inferring which aspect of quality is most important is more difficult. Table 3 shows that average faculty salary has the highest t-value, closely followed by the average SAT scores of entering freshmen and Astin's measures of intellectuality and selectivity. One is tempted to conclude that faculty quality and peer group effects are the most important (in terms of subsequent earnings) features of college quality. The peer group effects were in line with the conclusions of James Coleman et al. (1966) in his study of lower levels of education.

The R^2 in the earnings function before adding the quality variable was .0602. The addition of the average salary variable raised the R^2 by .0223 to .0825. Once again, the quality variables measuring student characteristics added the next largest amounts to R^2.[20]

The per-student expenditure variable added the least to R^2. This might be explained by the fact that they were deflated by the number of full-time equivalent students. Indeed, average faculty salary, a prime component of expenditure, was the most powerful measure of quality. Welch (1966) has argued that for state elementary and high school systems, size is a factor having a significant positive effect on earnings; i.e., an important aspect of school quality as quality is defined here. If scale economies are a positive aspect of college quality, then the expenditure data deflated are actually a ratio of two factors, each a positive influence on earnings. If expenditures per student are high because expenditures are high, holding constant size of college, one would expect a strong positive relationship with later earnings. On the other hand, if the variable is large because number of students is small, holding expenditures constant, one would expect a negative relationship between the ratio and income. In a large sample of schools, the expenditures per student probably vary for both reasons, and so the overall effect is blurred. Moreover, only part of each dollar spent finds its way into projects which make students more productive (i.e., what value is there to earning ability of gardening expenses for the college greenery?). Of course, a happier student may learn more and, hence, earn more.

One can calculate an income elasticity of quality—the percentage change in income for a percentage change in quality. However, these elasticities cannot be used to compare impacts of quality. A 1% change in average SAT level is not comparable to a 1% change in average salary. These elasticities are presented in Table 3 (second line from the bottom). If one could calculate the cost of a 1% change in each of the quality measures, only then could one see the returns to each.

Table 4 presents two specifications of the earnings equation which include more than one quality variable. In the first, it is evident that average salary and SAT scores have separate and statistically significant influence on income. The second version shows that when additional types of quality measures are added, the importance of faculty and student effects still stands out, but the other variables add nothing extra statistically. It appears that two separate and important aspects of quality can be identified, namely, faculty quality and peer group (student) effects.[21] The other variables to measure quality apparently relate to income only as proxies for these two effects.[22]

Results at Different Points on the Life Cycle

College quality, no matter how defined, does affect earnings 20 years after attending. It is also interesting to ask whether or not quality of college has an increasing or decreasing effect on earnings over time. To this end, earnings functions which in-

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[19]Taubman and Wales (1972) estimated an upward bias in the coefficient on years when IQ was omitted of about 30%.

[20]It has been suggested that the *average* college SAT variable might be a better proxy for the innate ability of the particular student than was the ability variable used. The average SAT variable may be picking up ability traits of the individual not captured by the individual ability measure. If this were the case, the suggestion of a peer group effect would be wrong. To really confirm the peer group effect would require both individual and college SAT scores, but we lacked the former. It would also be useful to have variance of SAT by college, which is not available.

[21]As stated earlier, the significance of the average SAT scores might be measuring the effects of students' own abilities not captured by IQ. However, there seems to be no reason why 1963 SAT would better represent ability than would the ability measures taken in the Air Force usually before college attendance.

[22]Of course, it might be that other aspects of quality are important but are omitted from the model or merely poorly measured.

TABLE 4

Earnings Functions with Several Quality Variables

Constant	1.332	1.300
	(6.761)	(5.665)
IQ	.03105	.03099
	(4.285)	(4.265)
Years of education	.03053	03055
	(4.206)	(4.190)
Experience	.03781	.03766
	(2.827)	(2.310)
Experience^2	-.0009073	-.0009029
	(-2.756)	(-2.736)
Average salary	.00003392	.00003342
	(3.343)	(2.108)
SAT verbal	.0006215	.0005807
	(2.272)	(1.848)
Expenditures: Inst. Dept., Res., Library		-.00001069
		(-0.2147)
Astin selectivity		.001087
		(0.3269)
Gourman academic		.00001541
		(.07664)
R^2	.08564	.08573

clude two quality variables were estimated: undergraduate college quality for those with 16 or fewer years of schooling and quality of graduate school for those who attended to explain log of 1969 income, log of 1955 income, and log of real income in the initial year of full-time employment.[23]

A positive correlation between Q_{UG} and Q_{GRAD} for those with more than 16 years implies the coefficient on graduate quality is higher than it would be if Q_{UG} were entered for those with more than 16 years. When this was done, the Q_{UG} variable was not significant for those with more than 16 years.

Three different quality measures were used: the Gourman Index, average faculty salary, and average level of SAT math scores of entering freshmen.[24] The results appear as Table 5. The three 1969 regressions are comparable to Columns 1, 3, and 5 of Table 3, where the quality last variable is not separated by years of attainment. Also, in Table 5 four occupational dummies were inserted to account for exceptional income-schooling relationships. Pilots generally had high earnings considering their education. Teachers usually had much schooling and low incomes due to fewer hours and alleged nonpecuniary rewards. Doctors had high incomes, partially due to monopoly elements in their profession; however, the reason for high pay for lawyers is less clear. The average of coefficients on Q_{UG} and Q_{GRAD} was not much different than the comparable coefficients in Table 3.

Quality did have a significant influence on 1955 earnings; however, no matter how quality was measured, the coefficients were smaller in 1955 than in 1969. It should be noted, however, that in terms of significance of the quality variables (t-tests or addition to R^2), the 1969 and 1955 results are rather similar. Moreover, IQ had roughly the same effects on earnings in both years, and for some reason the coefficient on experience was greater in 1955. Another difference is that the coefficient on years of education variable was smaller when using 1955 education. It should be noted that in 1955 respondents averaged about 6.6 years of experience. There is evidence that there is a positive relationship between years of education and investment in on-the-job training. It is likely that those with more years of schooling had been foregoing more earnings while investing on the job in the first few years of employment. However, by 6 years out, returns to all human capital acquired appear, and so differences in income by education are clouded. On the one hand, more earnings are foregone by the more highly educated as they obtain more training. On the other hand, this group begins to reap returns to their human capital. The less-educated group invests less in OJT (less income is foregone), but their earnings are lower.

Table 5 also shows earnings functions explaining income in the initial year of employment (when experience for each respondent was zero). Years of education still had a significantly positive effect with coefficients of over .045. If the argument concerning the 1955 regressions were true, one would expect a

[23]Since starting year differed among individuals, the first-year incomes had to be adjusted to account for year-to-year price-level changes.

[24]Individuals were eliminated unless all three appropriate quality measures were available for them. When the regression for Gourman was rerun *not* eliminating for absent SAT or salary data, the sample was larger, of slightly lower IQ, and had slightly lower average college quality. In that case, for all three years both the Q_{UG} and Q_{GRAD} had smaller (but significant) coefficients. This indicated a positive interaction between IQ and school quality.

TABLE 5

Earnings Functions at Different Times in the Life Cycle

	Gourman overall			Average faculty salary			SAT-Math		
	Real INIT	1955	1969	Real INIT	1955	1969	Real INIT	1955	1969
Constant	.7358	.8621	1.401	.6400	.6908	1 068	.6262	.5685	.9939
	(3.722)	(4.638)	(6.267)	(2.980)	(3.532)	(4.525)	(2.670)	(2.719)	(3.989)
Years of education	.0452	.0306	.0487	.0459	.0324	.0516	.0458	.0333	.0537
	(3.679)	(2.883)	(4.105)	(3.723)	(3.043)	(4.332)	(3.672)	(3.080)	(4.408)
IQ	-.0255	.0274	.0300	-.0272	.0250	.0257	-.0263	.0264	.0279
	(-3.105)	(4.421)	(4.005)	(-3.264)	(3.975)	(3.414)	(-3.164)	(4.187)	(3.681)
Experience	——	.0536	.0338	——	.0535	.0383	——	.0518	.0318
	——	(4.639)	(2.511)	——	(4.636)	(2.850)	——	(4.466)	(2.353)
Experience^2	——	-.0023	-.00076	——	-.0023	-.0009	——	-.0022	-.0007
	——	(-4.062)	(-2.308)	——	(-4.128)	(-2.675)	——	(-3.885)	(-2.189)
$Z \times Q_{UG}$	.00015	.00065	.00074	.00002	.00005	.00006	.0003	.0010	.0013
Z=1 if UG	(1.074)	(6.195)	(5.949)	(1.638)	(6.362)	(7.045)	(1.216)	(5.353)	(5.626)
Q_{GRAD}	-.00009	.00050	.00062	.000003	.00004	.0005	.00008	.0009	.0012
	(-.5931)	(4.450)	(4.818)	(.3127)	(5.272)	(6.192)	(.3032)	(4.600)	(4.977)
Pilot	.1420	.1866	.4111	.1394	.1859	.4060	.1435	.1947	.4244
	(1.045)	(1.828)	(3.306)	(1.026)	(1.824)	(3.282)	(1.055)	(1.901)	(3.409)
Teacher	-.1744	-.2787	-.3168	-.1767	-.2859	-.3206	-.1735	-.2790	-.3030
	(-2.548)	(-5.209)	(-4.420)	-2.585	(-5.349)	(-4.491)	(-2.535)	(-5.192)	(-4.213)
M.D.	.0735	.6446	.6488	.0837	.6301	.6436	.0842	.6521	.6373
	(.3550)	(4.111)	(3.619)	(.4049)	(4.024)	(3.611)	(.4068)	(4.139)	(3.552)
Lawyer	-.1766	.0167	.1759	-.1720	.0171	.1802	-.1727	-.0130	.1532
	(-1.807)	(.2043)	(2.000)	-1.761	(.2098)	(2.060)	(-1.766)	(-.1583)	(1.741)
R^2	.0186	.1201	.1205	.0195	.1215	.1291	.0190	.1136	.1184
Observations	1397	1199	1394	1397	1199	1394	1397	1199	1394

negative relationship between income and years of schooling in the first year in the labor force. The argument is that the more educated person is investing further by giving up income to acquire on-the-job training. Here it appears the more educated earn *more* in the first year.

The IQ variable now becomes significantly negative, perhaps indicating a tendency for those more able to invest more in on-the-job training in initial years in the labor force. If the relationship between ability and investment in on-the-job training is stronger than that between years of education and OJT, this might explain why the coefficient on years remains significantly positive in the initial year earnings functions.

Schooling quality is *never* statistically significant in the initial year earnings functions for either those with 16 or fewer years or those with graduate training. It is apparent that the importance of college quality grows with experience in the labor force. One reason might be that students in better colleges are better prepared to benefit from on-the-job training in their post-school lives.

Interactive Models

In this section two main questions are asked: (a) How does college quality affect different types of people in the sample? and (b) How does quality interact with other variables in the earnings equations?

First, separate regressions similar to those presented in Table 3 (i.e., including IQ, YRSED, EXP, and EXPSQD along with last quality) were estimated for individuals in the sample with IQs above the sample mean (700 observations) and below the mean (811 observations). The question asked is whether the effect of quality differed according to the ability of those who attended. Table 6 presents the elasticities derived as the product of the coefficient on quality (d 1n Y/dQ) and the mean values of quality. According to the t-test, the impact of quality was significantly greater for the higher-ability subsample for all definitions of quality but one.[25] (For SAT math the elasticities were not significantly different.) These regressions from which Table 6 is derived revealed that coefficients on IQ were generally smaller for the high-ability group, and that the coefficients on years in school and experience were generally larger for the high-ability group. The model explains 9 to 10% of the variance in 1969 income for those with ability above the mean, but only 4 to 5% of the variance of income of the lower-ability group was explained.[26]

These results lead us to separate the sample further, into ability quartiles. Table 7 presents the coefficients on quality (measured by the Gourman Index, since it was available for the largest number of schools), undergraduate quality for those with 16 or fewer years, and graduate quality for those who achieved more than 16 years. One must remember that there were 10 variables in the earnings function, although only the quality coefficients and the elasticities are presented. For the lowest three ability quartiles, both the quality coefficients and the income elasticities of quality were larger for those who attended 16 or fewer years than for those with graduate work. For the top ability quartile, quality meant more for those who had had graduate work. Also, the effect of quality appeared greatest, no matter the number of years, for those in the highest ability quartile. Next greatest impact of quality was on those in the lowest ability quartile. The students in the middle two ability quarters saw their incomes least influenced by quality of college. One has to conclude that the interaction between college quality and individual ability is nonlinear. Since those in the lowest IQ quartile probably attended the poorest quality schools, then this result tends to confirm that differences in college quality are most important for low-quality schools. These results pertaining to quality from IQ quartile regressions are invariant to the particular measure of quality used and to the addition of several other background variables into the earnings function.

Tables 6 and 7 indicate that college quality does influence incomes of the more able students more than it influences incomes of other students. Columns 3 and 4 of Table 8 reveal only a weak linear interaction between quality (now measured as average SAT verbal and average faculty salary rather than the Gourman Index) and IQ. This is to be expected due to the previous[27] indication of nonlinearity.

Table 8 also tests for several other types of linear interactions. These regressions are comparable to those in Table 2 (where the R^2, when SAT verbal was the quality measure, was .07885 and, when quality is measured by average salary, was .0825). The negative coefficient on quality squared (SAT verbal) suggests a slight lessening of the impact of quality as the level of quality rises. Finally, the effect of the quality of the last school attended did not seem to be a linear function of the number of years attended (Columns 5 and 6). This result is not surprising in light of the relative importance of quality to those who do and do not have graduate training demonstrated in Table 7. The earnings functions' explanatory power was only slightly improved by the addition of the interaction term.[28]

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[25]The t-test was $H_0 : B_H = B_L$, where B_H is the coefficient of quality for the high-ability half of the sample and B_L is the quality coefficient for the low-ability half.

[26]When SAT and average salaries were put in together, their effects were both more significant (t-test) and larger (size of coefficient) for the high IQ half of the sample.

[27]Here the interaction term is specified as the product of the two variables concerned. That is, if

$$1n\ Y = a + b\ QUAL + c(QUAL) \times (IQ)$$

then $$\frac{d\ 1n\ Y}{dQ} = b + c\ IQ$$

which differs statistically from b if c is significantly different from zero. This is a specific type of interaction. The high correlation between QUAL and (QUAL) x (IQ) tends to cloud the interpretation of the results. A quality squared term tests whether the effect of quality depends on its *level*.

[28]Since both SAT verbal and average salary were significant when used together, their combined interactions were studied in a single regression. The coefficient on the product of the two quality variables was not different from zero, indicating that the relationship between either quality measure and income is independent of the level of the other quality measure. The coefficients on the squared quality terms and on each quality measure times years were not significant. However, the coefficient on the SAT x IQ variable was significant according to the t-test (positive), and the average salary x IQ coefficient was almost significant (negative).

TABLE 6

Income Elasticities of Quality[a]

	Gourman overall	Gourman academic	Average salary	SAT Verbal	SAT Math.	Expenditures: instr., dept. res., and lib.	Basic income	Basic expenditures	Astin intell.	Astin select.
All observations	.3020	.3002	.4985	.6600	.7256	.1524	.1548	.0924	.5060	.6021
High IQ	.3563	.3654	.5761	.7703	.6937	.1744	.2143	.1217	.5762	.6862
Low IQ	.2492	.2375	.4328	.5636	.7579	.1283	.0850	.0480	.4470	.5207
t[b]	5.003	5.9337	3.3917	2.9093	.8230	5.6336	13.1944	8.8326	2.8618	2.5765

[a]Controlling for YRSED, EXPER, EXPERSQD, and IQ.

[b]The tests are whether there are significant differences in the elasticities for the high and low IQ parts of the sample. Differences are significant where t-values exceed 2.0 (approximately).

The sample was divided into those with IQ above the mean and those below the mean of the whole sample of 1511.

TABLE 7

Income Elasticities of College Quality by IQ Quartiles

	Low IQ	2	3	High IQ
Coefficient on $Z \times Q_{UG}$	.00094	.00061	.00050	.00097
(t-value)	(3.674)	(2.794)	(1.922)	(5.041)
Mean Q_{UG}	476.5	490.6	503.5	528.0
Elasticity	.448	.299	.252	.512
Coefficient on Q_{GRAD}	.00045	.00026	.00028	.0011
(t-value)	(1.691)	(1.138)	(1.044)	(5.393)
Mean Q_{GRAD}	501.6	518.6	532.1	552.0
Elasticity	.226	.135	.149	.607
Observations	376	421	338	434

Notes: The quality measure used is the Gourman Overall Index since this was available for all schools.

The coefficients are from an earnings function explaining ln of 1969 income by years of education, experience, experience squared, IQ, and dummies for teachers, MDs, lawyers, and pilots.

Income elasticities of quality are the coefficients times the mean quality.

$Z = 1$ if education $\leq$ 16 years and 0 otherwise.

The earnings functions were then rerun to include three interactions simultaneously: quality and IQ, quality and years of education, and IQ and years. When this formulation was estimated for the whole sample, only weak interactions between quality and IQ (generally positive) and quality and years of education (generally negative) were found. The interaction between IQ and years was never significant. Of course, by now multicollinearity is becoming a problem.

However, when only those with IQs above the sample mean were included, a significant interaction (negative) between IQ and years was revealed. The interactions with quality now appeared weaker than for the whole sample. The estimates using people below mean IQ did not show a significant IQ x years interaction, but the interaction between quality and years (negative) became stronger.

The results just discussed are not presented in a table here for brevity. The implication from this discussion is that for people with below-average IQ, quality of college attended is more important for earnings the fewer years of college attended. Also, for people with above-average ability, the relationship between IQ and income is stronger the fewer years of education obtained. One problem with these formulations is that the arguments in the interactive earnings function become highly correlated. The strong differences revealed when the simple earnings function was run for subsamples, compared with the results from the interactive model, lead us to stress the procedure of dividing up the sample and running regressions for subsets of observations.

Table 9 contains simple earnings functions for the sample divided not only into high and low IQ groups, but within these, into those who attended high- or low-quality colleges.[29] These regressions indicated that the impact of quality, as measured by average SAT scores (math) of entering freshmen, was greatest at poorer schools. The coefficient on quality was .002 in both quarters of the sample where quality was below average and .0012 for the high quality—high ability group. The income elasticities of quality followed the same pattern. Interestingly, for the low individual IQ, high-average SAT group, the coefficient on quality was not significantly different from zero. The t-values on average SAT were highest for the low school quality group as well.

These regressions indicated a higher return to years of education for the high-ability people, regardless of college quality. The only group where IQ seemed to be less important than others in terms of later earnings was where high-ability people attended poor schools. Returns to experience were also higher for the high-ability group.

The researcher also tested for interactions within each of these four parts of the sample. There were only a few significant interactions. There was a significant negative coefficient on the quality times years variable for the high-ability, low-quality group and a strong positive interaction between quality and ability in the low-ability, high-quality group. The interaction terms did add somewhat to the power of the model, but not a great deal. The earnings functions for people falling into each of the four categories did look different. However, precise patterns by school quality and individual ability were not immediately visible.

Table 10 looks at earnings functions for those with 16 or less years of schooling and those with 17 or more years separately. Columns 1 through 6 contain only respondents who had data for all three quality measures—SAT, average faculty salary, and Gourman—for their undergraduate schools and for their graduate school if they attended. Columns 7 through 10 contain a larger sample, omitting only those without Gourman and expenditure data. The larger sample had a lower mean IQ and lower average quality (Gourman) schools. In only one case (Gourman—larger sample) was undergraduate quality statistically significant for those who went on to graduate school. In almost all cases impact of last quality was greater (or equal) for those with more years; clearly, effects of quality are greater for this group if one combines effects of undergraduate *and* graduate quality. These results are at odds with some presented earlier where the impact of quality was greater for those with 16 or less years, except for those in the highest ability quartile. However, here one is no longer constraining the coefficients on other variables to be the same since we estimate different functions by years of schooling. Also, those with 17 or more years surely were of the highest ability, and so the interaction between IQ and quality is evident again.

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[29]That is, there are four regressions:

1. Those with ability greater than the sample mean attending schools with average math SAT of entering freshmen above the sample mean.

2. Those with high ability attending below-average quality colleges.

3. Those with low ability attending above-average quality colleges.

4. Those with low ability attending below-average quality colleges.

TABLE 8

Earnings Functions with One Interaction Term

	SAT Verbal (1)	Average salary (2)	SAT Verbal (3)	Average salary (4)	SAT Verbal (5)	Average salary (6)
Constant	.3754	1.587	1.390	1.527	1.850	1.023
	(.4927)	(4.066)	(6.994)	(8.415)	(1.896)	(1.481)
IQ	.03417	.03256	-.05133	-.004114	.03395	.03234
	(4.700)	(4.473)	(-.8881)	(-.1029)	(4.668)	(4.441)
Years of education	.03635	.03324	.03667	.03356	.006485	.06290
	(5.078)	(4.605)	(5.125)	(4.649)	(.1090)	(1.550)
Experience	.03067	.03512	.03153	.03570	.03035	.03591
	(2.306)	(2.640)	(2.368)	(2.682)	(2.279)	(2.692)
Experience^2	-.0007403	-.0008400	-.0007506	-.0008512	-.0007259	-.0008590
	(-2.263)	(-2.567)	(-2.294)	(-2.600)	(-2.217)	(-2.617)
Quality	.004657	.00003413	-.001058	.00004472	.0002603	.00009465
	(1.770)	(.5338)	(4.788)	(5.382)	(.1504)	(1.461)
Quality^2	-.000003083	.5805 D-9[a]				
	(-1.343)	(.2027)				
Quality x IQ			.0001517	.000003481		
			(1.488)	(.9324)		
Quality x yrs.					.00005415	-.000002889
					(.5094)	(-.7416)
R^2	.08110	.08425	.08136	.08476	.08015	.08456

[a]D-X means move decimal point X places to the left.

Conclusion

Astin (1971) has said that "The available evidence suggests that for students there is little or no intellectual 'value added' from attending a highly selective college [pp. 633-634]." However, this paper argues that high income in later life is an important goal of higher education, the attainment of which is powerfully affected by several dimensions of college quality.

Two distinct dimensions of college quality have been identified: peer group effects, measured by average SAT scores of entering freshmen at a college, and faculty quality, measured by average faculty salary. College quality has increasing impacts on earnings over time, i.e., the income elasticity of quality is not statistically significant in the initial year of employment and is greater after 20 years than after 7 years, although both of the latter are significant.

College quality appears to have a greater impact on incomes for high-ability students than for low-ability students as seen when comparing earnings functions estimated separately for the top and bottom halves of the sample by IQ. Also, the multiplicative interaction terms for quality and IQ were positive and almost statistically significant. When earnings functions were estimated for the sample divided into IQ quartiles, the coefficient on college quality rose steadily between the second lowest IQ quartile and the highest; however, the lowest quartile was affected by quality almost as much as the highest (more than the second and third quartile). This can also mean quality differences matter more for those in poor-quality colleges (usually attended by those with low IQ).

When divided into IQ quartiles, the sample revealed that the coefficient on undergraduate quality was greater for those with 16 or fewer years than was the coefficient on graduate quality for

TABLE 9

Simple Earnings Functions for Subsamples Divided by Own Ability and School Quality

	Individual high IQ	Individual high IQ	Individual low IQ	Individual low IQ
	High SATM average student	Low SATM average student	High SATM average student	Low SATM average student
Constant	.6447	.4154	2.726	1.105
	(1.402)	(.8258)	(5.402)	(2.785)
IQ	.0345	.0105	.0487	.0436
	(1.835)	(.4948)	(1.913)	(2.267)
Years of education	.0543	.0621	.0233	.0282
	(4.124)	(4.733)	(1.740)	(2.721)
Experience	.0534	.0300	-.0089	.0289
	(2.207)	(1.250)	(-.3646)	(1.427)
Experience^2	-.0010	-.00049	.0002	-.0007
	(-1.704)	(-.8318)	(.2782)	(-1.385)
Quality[a]	.0012	.0020	-.00008	.0019
	(2.208)	(2.467)	(-.1231)	(3.112)
R^2	.0764	.0792	.0185	.0486
Observations	494	465	448	656
Mean IQ	1.96	1.74	-1.01	-1.15
Mean SATM	633	539	620	529
$\frac{\% \Delta \text{ Income}}{\% \Delta \text{ Quality}}$	.7536	1.178	-.0496	1.0051

[a]Quality measured by average SATM scores of entering freshmen.

those who went on in all quartiles, except the highest IQ where the relative sizes of coefficients were reversed. For graduates, undergraduate quality is omitted so the coefficient on graduate quality was biased upwards. However, when the sample was divided according to those with more than 16 years and those with no more than one degree, it appeared that the former revealed greater impacts of quality, which included both graduate and undergraduate. This result was probably due to the higher ability of those with more than 16 years. Sample size limitations precluded more detailed subdivision of the sample.

Data on the Gourman Index were available for more schools than were data on average SAT scores and average faculty salary. For comparison, the sample usually studied was the subset of people for whom all three relevant measures were available. As a check, the earnings functions were rerun for the larger sample which had Gourman only. This larger sample was of somewhat lower mean ability (and had a lower average Gourman Index). The quality variables were still significant and revealed the same patterns, but the coefficients were *smaller,* once again revealing a positive interaction between ability and quality.

There is some weak evidence that differences in quality are more significant at low-quality schools than at better institutions. There also seems to be a negative relationship between college quality and years of education in terms of future earning power, except for those at the top of the ability distribution. From all this, two general observations can be made: First, individual ability complements college quality;

TABLE 10

Separate Earnings Functions for Those with Undergraduate Training Only and for Those with Graduate Work (Dependent Variable Log of 1969 Earnings)

							Generally Poorer Students at Poorer Schools			
	SAT Math		Average faculty salary		Gourman overall		Gourman overall		Expenditures for fac., research & library	
	UG only	GRADS only	UG	GRAD	UG	GRAD	UG	GRAD	UG	GRAD
Constant	.9672	1.142	1.063	1.157	1.334	1.412	1.414	.6265	1.520	1.009
	(3.463)	(1.733)	(4.019)	(1.852)	(5.347)	(2.278)	(8.650)	(1.842)	(9.539)	(3.027)
Years of education	.0602	.0349	.0602	.0410	.0594	.0378	.0593	.0827	.0602	.0804
	(4.292)	(1.289)	(4.299)	(1.551)	(4.226)	(1.417)	(6.390)	(5.818)	(6.512)	(5.639)
IQ	.0227	.0397	.0215	.0376	.0249	.0414	.0243	.0299	.0246	.0331
	(2.497)	(2.854)	(2.367)	(2.800)	(2.755)	(3.112)	(4.035)	(3.828)	(4.108)	(4.229)
Experience	.0281	.0328	.0353	.0247	.0307	.0185	.0178	.0066	.0189	.0097
	(1.861)	(.8828)	(2.327)	(.6847)	(2.028)	(.5054)	(1.794)	(.3346)	(1.909)	(.4888)
Experience^2	-.0006	-.0006	-.0008	-.0005	-.0007	-.0003	-.0003	.0002	-.0004	.00006
	(-1.757)	(-.6581)	(-2.197)	(-.4916)	(-1.883)	(-.2578)	(-1.352)	(.2935)	(-1.468)	(.1094)
Q_{UG}	.0012	.0002	.00005	-.0000008	.0006	.0002	.0006	.0004	.0002	.00003
	(4.476)	(.4338)	(4.891)	(-.0505)	(4.170)	(.7166)	(5.415)	(2.979)	(5.780)	(1.014)
Q_{GRAD}		.0012		.00007		.0009		.0007		.0002
		(2.610)		(5.042)		(4.247)		(5.357)		(5.531)
Pilot	.4336	.2743	.4137	.2894	.4236	.1116	.4946	.4140	.4949	.5067
	(3.278)	(.6075)	(3.135)	(.6599)	(3.200)	(.2502)	(4.934)	(1.435)	(4.940)	(1.748)
Teacher	-.3311	-.2781	-.3423	-.2907	-.3254	-.2791	-.3115	-.2938	-.3172	-.3030
	(-1.713)	(-3.789)	(-1.775)	(-4.087)	(-1.680)	(-3.877)	(-2.818)	(-8.471)	(-2.873)	(-8.712)
M.D.		.6930		.7056		.7407		.6258		.5951
		(4.020)		(4.232)		(4.372)		(6.173)		(5.849)
Lawyer		.1967		.2281		.2270		.2238		.2253
		(2.039)		(2.446)		(2.401)		(4.362)		(4.378)
R^2	.0760	.2317	.0793	.2750	.0737	.2604	.0730	.3119	.0746	.3037
Observations	1074	320	1074	320	1074	320	2241	856	2241	856

and second, additional years in school are substitutes for college quality in the process of preparing to earn later.

Several limitations of these conclusions must be acknowledged. In the first place, only people in the upper half of the national ability distribution are included. However, if interactions between IQ and college quality are evident in the narrower IQ range, they should be even stronger with a more general sample. Secondly, no blacks are included. One of the implications of the "peer group" effect is an advocacy of "busing," which usually has involved an explicit attempt to alter racial compositions of schools. The results found here should not be generalized to the black-white case, although the results in Coleman (1966) and elsewhere look at both races and find similar effects of peers.

Finally, most of the work has not controlled for a number of important elements in the earnings process. When the researcher attempted to do so, the results pertaining to quality were not changed, except the coefficients were smaller. Family background was either not considered or measured by a three-way (high, medium, low) ranking of father's occupation. Karabel and Astin (1972) have recently argued that socioeconomic status is positively correlated with college quality. Moreover,

Hauser, Lutterman, and Sewell (1971) and Bowles (1972) have indicated that father's income should be used to measure status. If these points are correct, then our coefficients on quality are biased upwards, standing for *both* college attributes and family background.

However, the studies of income which stress socioeconomic background do not ask the same questions about interactions. Hence, the author cannot say whether the conclusions should be altered. As a last word, a call should go out for interaction among researchers of different focus, all of whom are seeking answers to essentially the same question—What causes different people to earn different amounts?

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